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POCKET CALCULATOR
for
LOCAL FIRE -DANGER
RATINGS

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INTRODUCTION

In 1964, Stockstad and Barney published tables that provided conversion factors for calculating local fire danger in the Intermountain area according to fuel types, locations, steepness of terrain, aspects, and times of day.² These tables were based on the National Fire-Danger Rating System published earlier that year. This system was adopted for operational use in Forest Service Regions 1 (Northern) and 4 (Intermountain) in 1965. These tables have since been incorporated into operating procedures of several Forest Service Regions and other forest protection agencies.

Since elaborate tables are often difficult to use rapidly and accurately, and since the information in the Stockstad-Barney tables has several varied uses, we have devised a pocket-sized calculator (see figs. 1 and 2 and the inserted sheet), somewhat on the pattern of a circular slide rule, that actually is two Spread Index conversion calculators. It facilitates rapid conversion of Spread Index values from the National Fire-Danger Rating System for estimating fire danger at spot locations some distance from a base fire-danger rating station and, at times, several hours after observation at the base station. It includes all the information available in the Stockstad-Barney tables. The sheet inserted in this pamphlet has circles printed that may be cut out and assembled as a small calculator that could be included as an optional item in a standard belt weather kit.

One side of the calculator provides for such variables as position on slope, time of observation, projected time interval following first observation, and exposure. The other side converts standard Spread Index values to rate of spread in chains per hour of increase in the fire's perimeter.

SPREAD INDEX CONVERSION METER FOR ELEVATION,

EXPOSURE, AND TIME OF DAY

This meter (constructed from circles A and C on the enclosed sheet) provides conversion factors for adjusting the Spread Index measured at either a valley bottom or a mountaintop base fire-danger rating station to probable Spread Index for a different location. The conversion can be made for the same time as the measurement

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²Conversion tables for use with the National Fire-Danger Rating System in the Intermountain area. U.S. Forest Serv. Res. Note INT-12, 6 pp. 1964.

at the base fire-danger rating station or can be projected for as long as 12 hours after the time of measurement at the base station. Conversion factors provided in this calculator can be applied to either the Timber Spread Index or the Fine-Fuel Spread Index.

Conversions adapted for exposure, elevation, and time of day are most nearly accurate during the main fire season and while the weather is settled. Conversion factors obtained from this calculator should be interpreted as relative rather than absolute. The major value of this calculator is its ability to disclose the differences in Spread Index that can be expected under given conditions of elevation, aspect, and time of day rather than as a means of determining the exact Spread Index applicable to a specific point at a specific time. The conversion factors indicate the direction and relative magnitude of these differences.

USES

Conversions of Spread Index values as influenced by differences in elevation, aspect, and time of day can greatly aid in understanding the effects of time and topography on fire danger. Some specific applications of Spread Index conversions are:

Prevention. --Patrol routes can be planned so that the patrolman arrives at a given area about the time of maximum fire danger for the day in that area.

Presuppression. --Manning can be better geared to probable fire danger in high risk areas.

Detection. --Lookouts and aerial observers can give special attention to high risk areas during any period when fire danger is near maximum.

Suppression. --Dispatching can be geared to probable danger at the fire site. If weather instruments are unavailable at the fire site, suppression personnel can plan fireline manning on the probable danger as indicated by this conversion meter.

DESCRIPTION

The Spread Index Conversion Meter, or calculator, consists of two concentric discs (fig. 1, a and b). The top disc, which is nearer you, has three cutaway "windows" and printed directions for use of the device. The outer rim of the lower, or center, disc a (so called because of its position between the top disc and a similar one on its other side) is divided into three equal sections to denote broad elevational zones; namely, "Lower 1/3 slope," "Thermal belt (midslope)," and "Upper 1/3 slope." The top window (c) shows readings for two variables in the conversion; namely, clock hour of initial reading (six choices), and direction of exposure. Readings for both north and east aspects are taken from "N" position, and readings for south and west aspects are taken from "S." The middle window (d) exposes three 4-hour-interval conversion factors for variations from Spread Index values from a valley bottom fire-danger base station. The bottom window (e) likewise shows three 4-hour-interval conversion factors for variation of Spread Index ratings from a mountaintop fire-danger rating station.

OPERATION

Conversion of Spread Index is accomplished in six steps by the following process.

Step 1. --Select the elevation zone (rim of center disc, a) that best corresponds to the area for which you wish a new Spread Index.

Step 2. --Rotate the top disc (b) until the windows are near the left edge of the elevation zone you selected on c.

Step 3. --Determine the clock hour when the base station (at valley bottom or mountaintop) Spread Index was measured and the aspect of the area for which you want a new Spread Index.

Step 4. --Rotate the top disc (b) clockwise until the desired combination of base station Spread Index observation time and aspect appear in the top window (c).

Step 5. --Use either the middle window (d) or the bottom window (e), whichever is appropriate, to obtain conversion factors for adjusting Spread Index measured at the base station.

Step 6. --To estimate Spread Index at another location at the same time the measurement is taken at base station, read the conversion factor opposite the "0" hour scale and adjust the measured Spread Index accordingly.

To estimate Spread Index at another location for a given number of hours after the observation at base station, read the conversion factor opposite the desired number of hours after base station reading, and adjust the measured Spread Index accordingly.

Make certain that you read conversion factors from the proper station location window.

Examples:

1. Figure 1 shows the Spread Index Meter set for 1000 hours and for calculating an adjusted Spread Index for a site on the lowest third of a north- or east-facing slope. Assume a Spread Index of 34 measured at a mountaintop fire-danger rating station. Adjusted index for the new location at present time ("0" hour) is $34 - 2$, or 32. For 1400 hours (4 hours hence) it would be $34 + 2$, or 36.

2. Assume a measured Spread Index of 22 at 0800 hours at a valley bottom fire-danger rating station. At the same time, the probable Spread Index for a south-exposed location at midslope would be $22 + 9$, or 31. Four hours later (noon), probable Spread Index would be $22 + 21$, or 43.

3. Assume a measured Spread Index of 46 at 1200 hours at a valley bottom fire-danger rating station. What would be the probable Spread Index for a site in the top third of a south-facing slope at 1600 hours? First, set the top window for 1200 hours on "S" in the "Upper 1/3 slope" section. The conversion factor for 4 hours hence from a valley bottom station is -2; so the adjusted Spread Index would be 44.

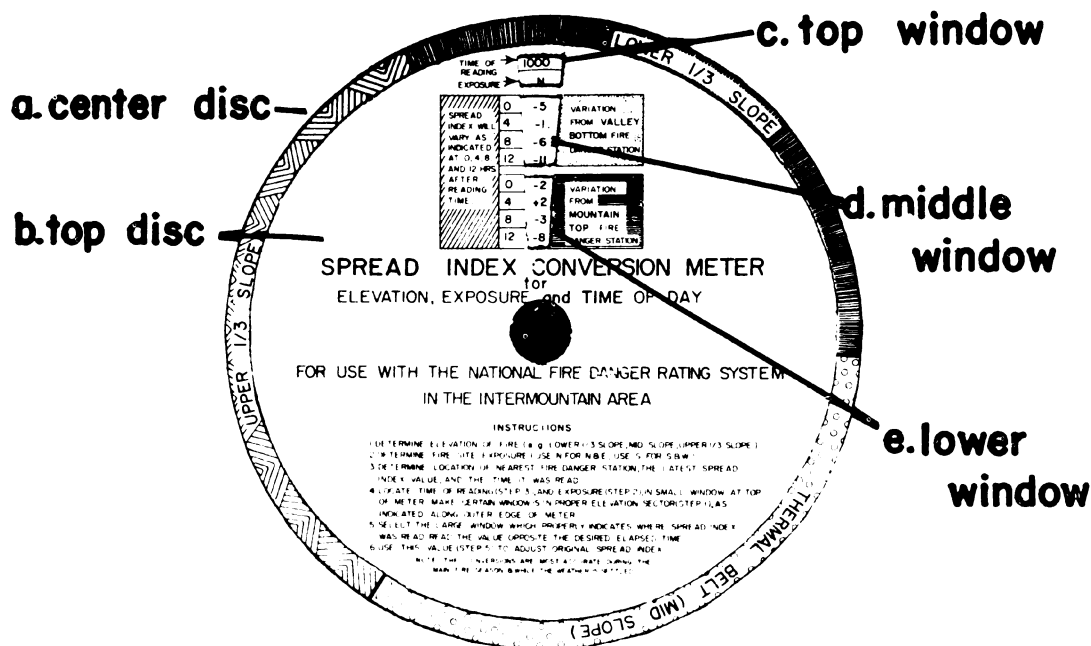


Figure 1. --Spread Index Conversion Meter for Elevation, Exposure, and Time of Day

SPREAD INDEX TO RATE-OF-SPREAD CONVERSION METER

The Rate-of-Spread Conversion Meter converts Spread Index values (both Timber Spread Index and Fine-Fuel Index) at the site of a fire to average initial rate of spread according to fuel type and slope steepness. Average initial rate of spread refers to the increase in perimeter of the fire, measured in chains per hour, between discovery of the fire and first attack. This rate of spread may be anticipated during the first 4 to 6 hours after ignition. This meter can be used to calculate rate-of-spread conversions for both Timber Spread Index and Fine-Fuel Spread Index.

APPLICATION OF SPREAD INDEX TO RATE-OF-SPREAD CONVERSIONS

Rate-of-spread conversions can provide information useful in fire control planning and fire suppression. Some specific applications are:

Planning. --Determinations of probable rate of spread for the various combinations of Spread Index, fuel type, and slope steepness can aid in estimating the manning necessary for different degrees of fire danger.

Suppression. --Spread Index measured at the fire site can be immediately interpreted in terms of rate of spread and used to determine fireline tactics and strategy.

Dispatching. --Base station Spread Index readings can be converted for elevation and exposure of the fire site and then further converted to rate of spread. While the information thus obtained is not quite as accurate as conversions of Spread Index measured at the fire site, it can greatly help a dispatcher in determining the approximate size and type of initial attack required.

DESCRIPTION OF CALCULATOR

Like the Spread Index Conversion Meter, this one consists of two concentric discs (fig. 2, a and b), a center disc, and top disc. The top disc has two cut-out windows and carries printed instructions for use of the device. The rim of the center disc is divided into five 72° sections that represent the five standard classifications of forest fuels according to rate of spread; namely, low, medium, high, extreme, and flash. The outer window on the top disc shows Timber Spread and Fine-Fuel Spread Index values from 1 to 100 in 10-unit groups; this classification is shown for all five fuel classifications. The lower window shows five rate-of-spread conversion values for reading opposite five percentage classes of steepness of slope; namely, 0-10, 11-25, 26-50, 51-75, and 75+. The rate-of-spread conversion values represent increase of fire perimeter in chains per hour.

OPERATION OF CALCULATOR

Operation of the Rate-of-Spread Conversion Meter is an easy sequence of six steps as described below.

Step 1. -- On the center disc (a), select the fuel-type classification that best fits the fuels in which the fire is burning.

Step 2. --Rotate the top disc (b) until the upper window shows the 1-10 Spread Index.

Step 3. -- Determine the Spread Index at the fire site by using the Timber Spread Index.

Step 4. --Rotate the top disc (b) clockwise until the outer window shows the correct Spread Index classification for the fire site.

Step 5. --Determine the slope percent at fire site.

Step 6. --In the lower window, read the average initial rate of increase of the fire perimeter (in chains per hour) opposite the slope-percent class.

Examples:

1. Figure 2 shows your meter set for a fire burning in a "Low" rate-of-spread fuel type on a 40-percent slope. Timber Spread Index measured at the fire site is 29. Accordingly, the estimated increase in the fire perimeter is about 2 chains per hour.

2. A fire in a "High" rate-of-spread fuel is burning on a 65-percent slope. Timber Spread Index at the fire site is 47. Estimated rate of perimeter increase is 15 chains per hour.

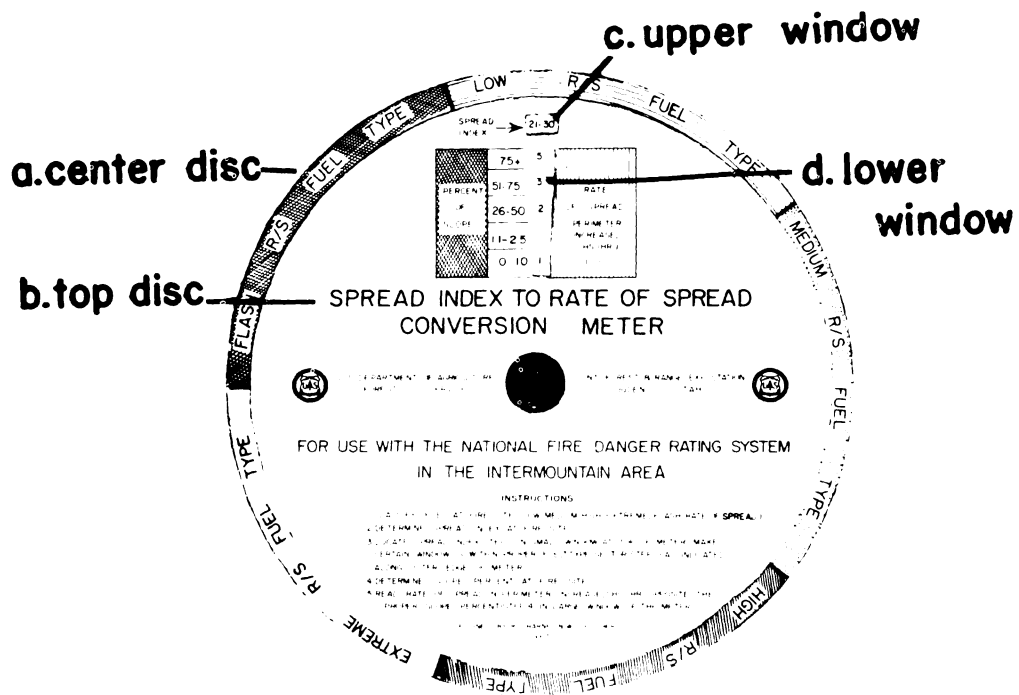


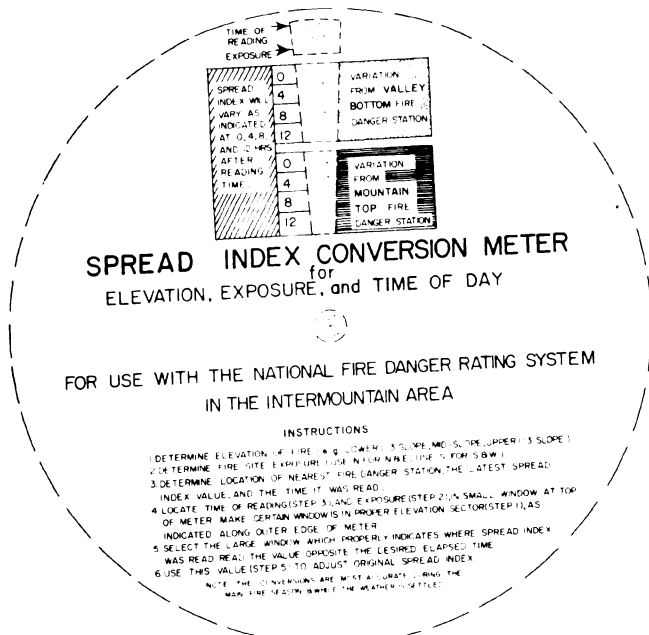
Figure 2. --Spread Index to Rate of Spread Conversion Meter.

3. A fire is burning in "Flash" fuel on a 50-percent slope. The Fine-Fuel Spread Index at fire site is 69. Hence, estimated rate of increase of this fire's perimeter is about 67 chains per hour.

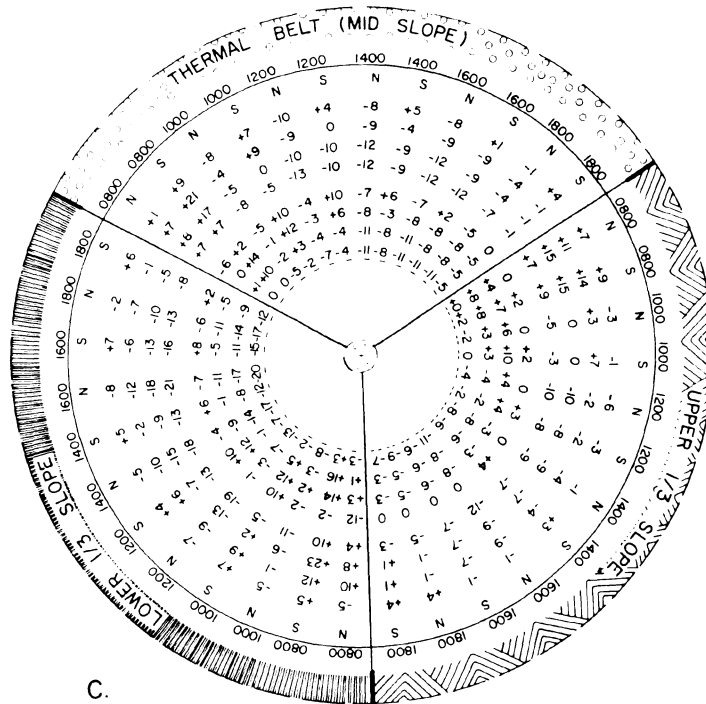
ASSEMBLING THE CALCULATOR

You can assemble your own calculator from the printed materials accompanying this folder by the following steps.

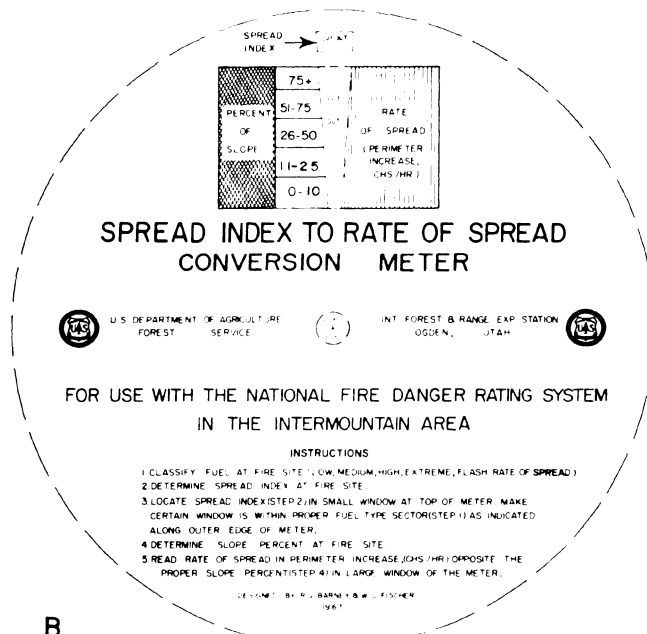
1. Cut out the four discs along the dotted lines.
2. Using a small sharp cutting instrument (scissors, penknife, safety razor blade), carefully cut out the center post holes on all four discs and the windows on discs A and B. Center post holes should be not more than 3/16 inch in diameter.
3. Glue or dry-mount the back of disc C to the back of disc D. Make sure that the center holes match and that the edges of the discs are bonded well.
4. To increase durability of the meter, you can cover the discs with plastic laminate, or you could dry-mount them on lightweight poster board and spray both sides with a high quality, clear acrylic lacquer before proceeding to the next step.
5. Place disc A over disc C (fig. 1).
6. Place disc B over disc D (fig. 2).
7. Insert a 3/16-inch Chicago center post to hold the discs together. Standard 3/16-inch Chicago center posts in a variety of lengths usually are available at office supply or stationery stores. Even the shortest center post available will need to be sawed or filed down to a length that will fasten the discs together snugly.
8. For additional protection, you can make a small plastic or light canvas envelope for covering the meter when it is not in use.



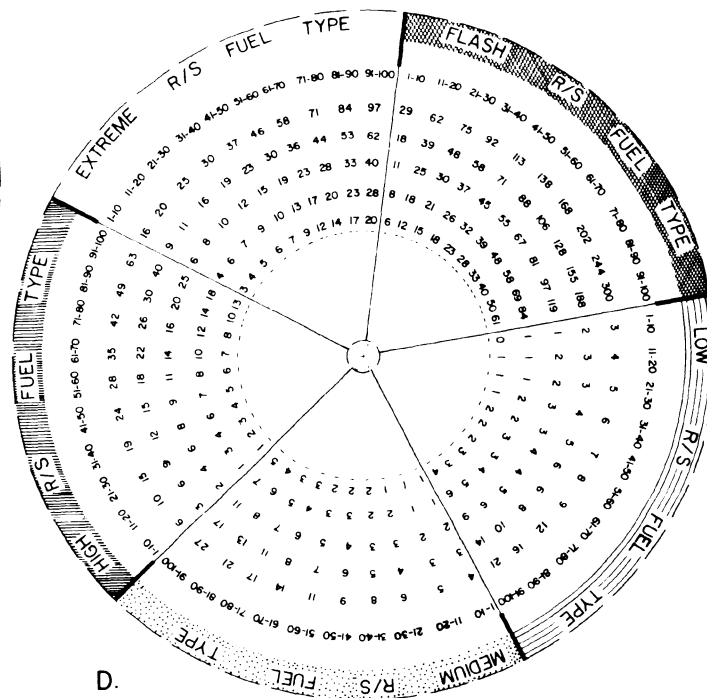
A.



C.



B.



D.